

# Macroeconomic Theory I

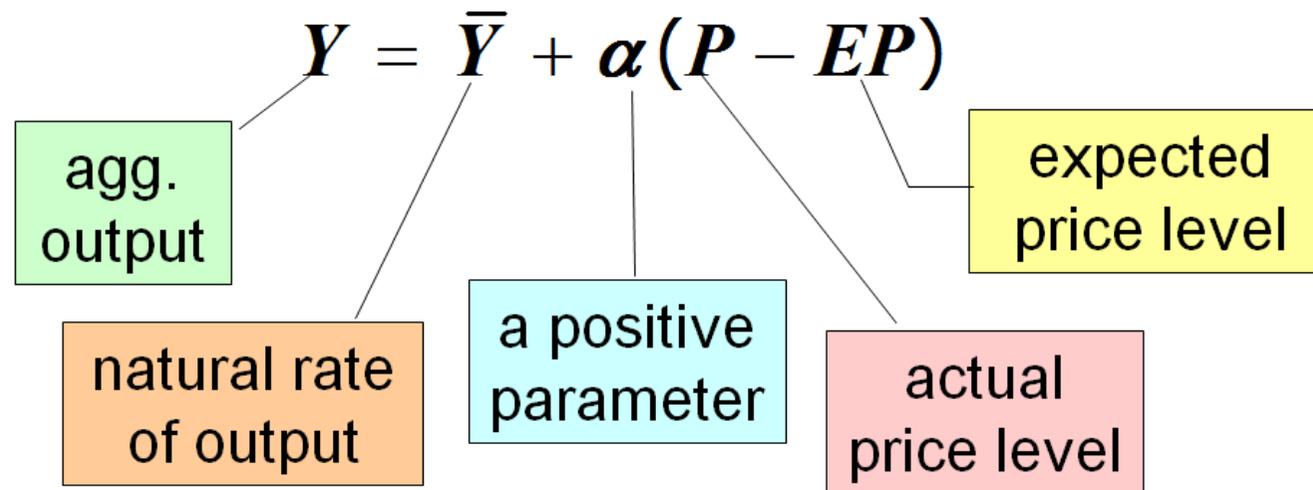
## Aggregate Supply

# Intro

- Up to now, we assumed that the price level  $P$  was “sticky” in the short run.
  - This implies a horizontal *SRAS* curve.
- Now, we consider two prominent models of aggregate supply in the short run:
  - Sticky-price model
  - Imperfect-information model

## Intro

Both models imply:



- Other things equal,  $Y$  and  $P$  are positively related, so the SRAS curve is upward sloping.

# The Sticky Price Model

- Reasons for sticky prices:
  - long-term contracts between firms and customers
  - menu costs
  - firms not wishing to annoy customers with frequent price changes
- Assumption:
  - Firms set their own prices (as in monopolistic competition).

## The Sticky Price Model

- The next few slides work out the math behind a sticky-price short-run supply curve
  - Starting with an individual firm's price setting behavior
  - Some firms will have the ability to change prices, while others will not, determining overall price level
  - Sticky-price firms will expect  $Y = \bar{Y}$
  - Then we'll solve out the equation for our SRAS curve

## The Sticky Price Model

- An individual firm's desired price is:

$$p = P + a (Y - \bar{Y})$$

where  $a > 0$ .

Suppose there are two types of firms:

- firms with flexible prices—set prices as above
- firms with sticky prices—must set their prices before they know how  $P$  and  $Y$  will turn out:

$$p = EP + a (EY - E\bar{Y})$$

$$P = s[EP] + (1-s)[P + a(Y - \bar{Y})]$$

price set by  
sticky-price firms

price set by  
flexible-price firms

- Subtract  $(1-s)P$  from both sides:

$$sp = s[EP] + (1-s)[P + a(EY - E\bar{Y})]$$

- Divide both sides by  $s$ :

$$P = EP + \frac{(1-s)a}{s}(Y - \bar{Y})$$

## The Sticky Price Model

- High  $EP \Rightarrow$  high  $P$ 
  - If firms expect high prices, then firms that must set prices in advance will set them high.
  - Other firms respond by setting prices high.
- High  $Y \Rightarrow$  high  $P$ 
  - When income is high, the demand for goods is high. Firms with flexible prices set prices high.
  - The greater the fraction of flexible-price firms, the smaller is  $s$  and the bigger the effect of  $\Delta Y$  on  $P$ .

## The Sticky Price Model

- Finally, derive the *SRAS* equation by solving for  $Y$  :

$$P = EP + \frac{(1-s)a}{s} (Y - \bar{Y})$$

$$Y = \bar{Y} + \alpha(P - EP)$$

where  $\alpha = \frac{s}{(1-s)a} > 0$

# Imperfect Information Model

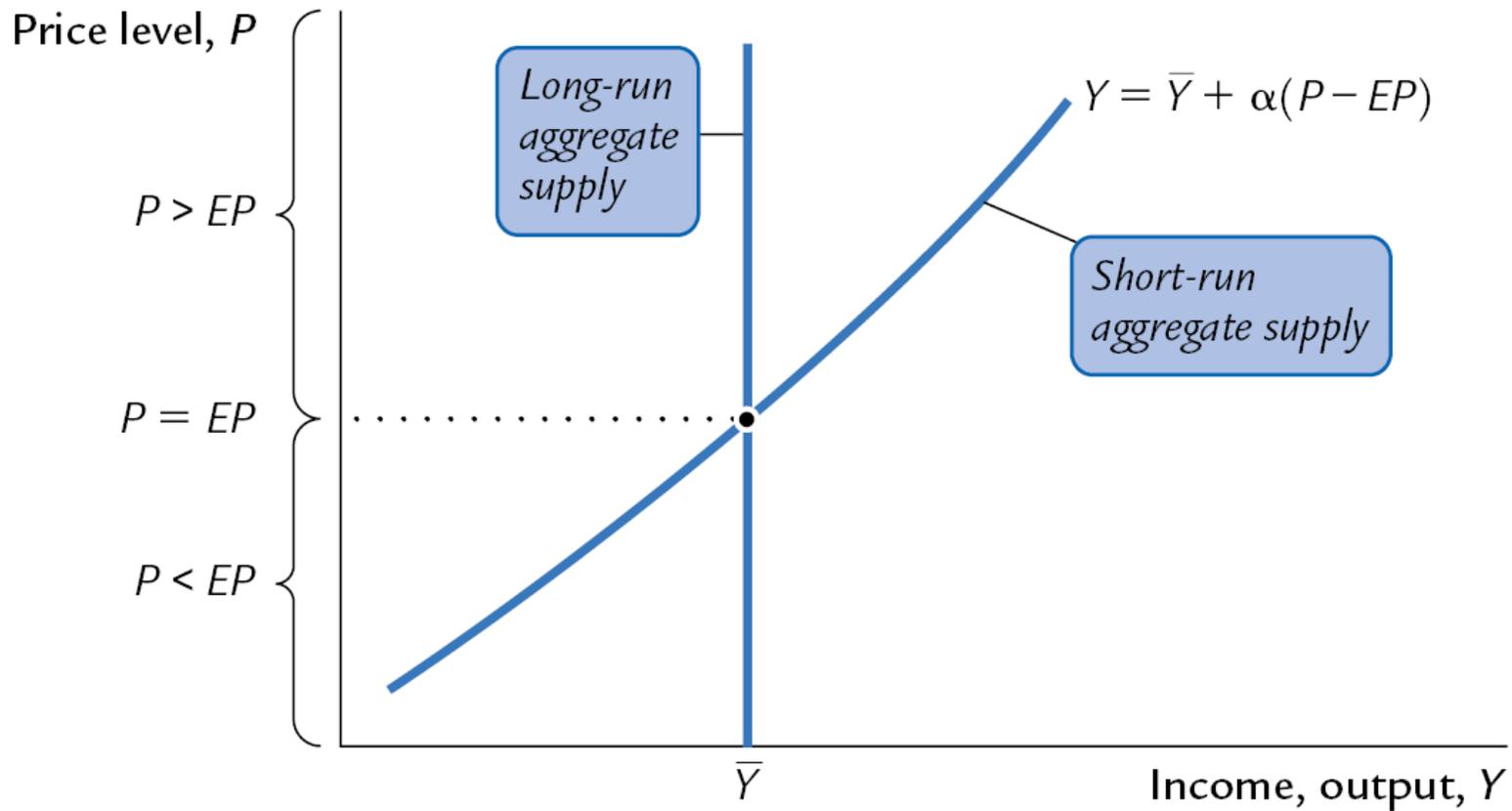
## Assumptions:

- All wages and prices are perfectly flexible, and all markets are clear.
- Each supplier produces one good and consumes many goods.
- Each supplier knows the nominal price of the good she produces but does not know the overall price level.

## Imperfect Information Model

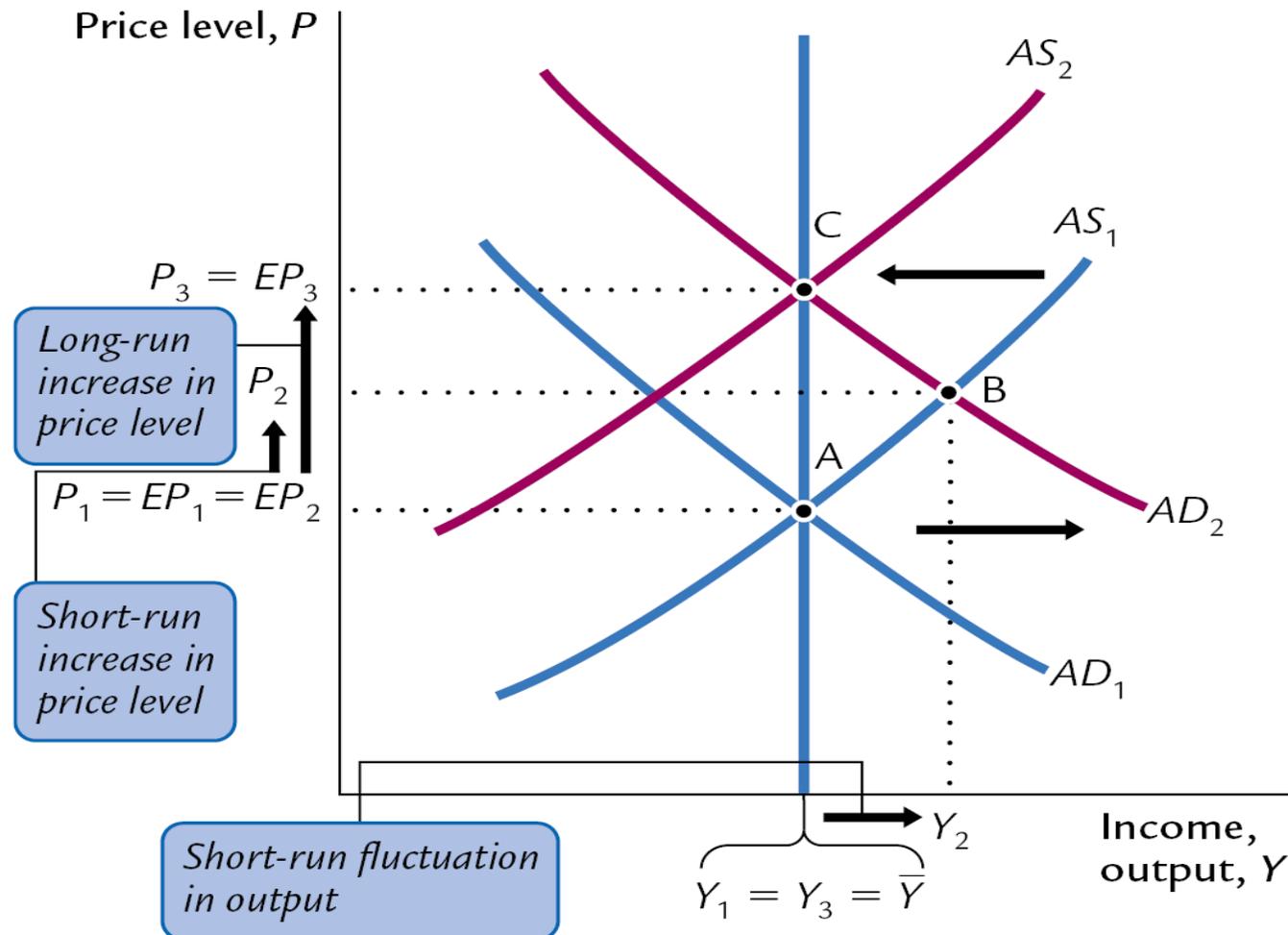
- The supply of each good depends on its relative price: the nominal price of the good divided by the overall price level.
- The supplier doesn't know price level at the time she makes her production decision so uses  **$EP$** .
- Suppose  **$P$**  rises but  **$EP$**  does not.
  - Supplier thinks her relative price has risen, so she produces more.
  - With many producers thinking this way,  **$Y$**  will rise whenever  **$P$**  rises above  **$EP$** .

# AS Curve for Short and Long Run



Mankiw, *Macroeconomics*, 11e, © 2022 Worth Publishers

# Effects of Expansionary Policy



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## Inflation, unemployment, and the Phillips curve

The **Phillips curve** states that  $\pi$  depends on:

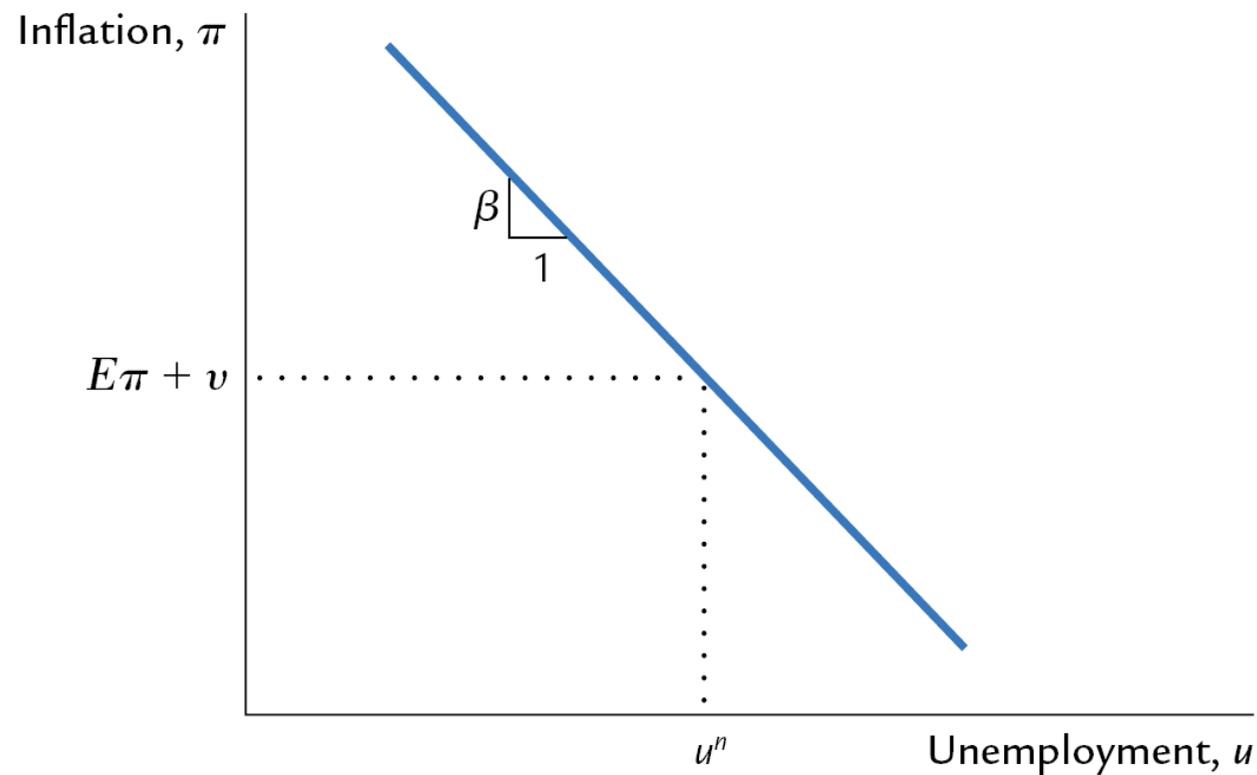
- expected inflation,  $E\pi$
- **cyclical unemployment**: the deviation of the actual rate of unemployment ( $u$ ) from the natural rate ( $u^n$ )
- supply shocks,  $v$  (Greek letter nu).

$$\pi = E\pi - \beta(u - u^n) + v$$

where  $\beta > 0$  is an exogenous constant.

# The Phillips Curve

In the short run, inflation and unemployment are negatively related.



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## Deriving the Phillips Curve

SRAS: 
$$Y = \bar{Y} + \alpha(P - EP) \quad (1)$$

Solving (1) for P yields: 
$$P = EP + \left(\frac{1}{\alpha}\right) (Y - \bar{Y}) \quad (2)$$

Adding the supply shock term ( $v$ ) to (2) yields:

$$P = EP + \left(\frac{1}{\alpha}\right) (Y - \bar{Y}) + v \quad (3)$$

Subtracting last year's price level ( $P_{-1}$ ) from both sides of (3) yields

$$(P - P_{-1}) = (EP - P_{-1}) + \left(\frac{1}{\alpha}\right) (Y - \bar{Y}) + v$$

## Comparing SRAS and Phillips Curve

SRAS: 
$$Y = \bar{Y} + \alpha(P - EP)$$

PC : 
$$\pi = E\pi - \beta(u - u^n) + v$$

*SRAS* => Output is related to unexpected movements in the price level.

PC => Unemployment is related to unexpected movements in the inflation rate.

## Adaptive Expectations

- **Adaptive expectations**: an approach that assumes people form their expectations of future inflation based on recently observed inflation.

- A simple version:

expected inflation = last year's actual inflation

$$E\pi = \pi_{-1}$$

- Then, Phillips curve equation becomes

$$\pi = \pi_{-1} - \beta(u - u^n) + v$$

## Inflation Inertia

$$\pi = \pi_{-1} - \beta(u - u^n) + v$$

In this form, the Phillips curve implies that inflation has inertia:

- In the absence of supply shocks or cyclical unemployment, inflation will continue indefinitely at its current rate.
- Past inflation influences expectations of current inflation, which in turn influences the wages and prices that people set.

## Two causes of rising and falling inflation

$$\pi = \pi_{-1} - \beta(u - u^n) + v$$

- **cost-push inflation:**

inflation resulting from supply shocks

Adverse supply shocks typically raise production costs and induce firms to raise prices, *pushing* inflation up.

- **demand-pull inflation:**

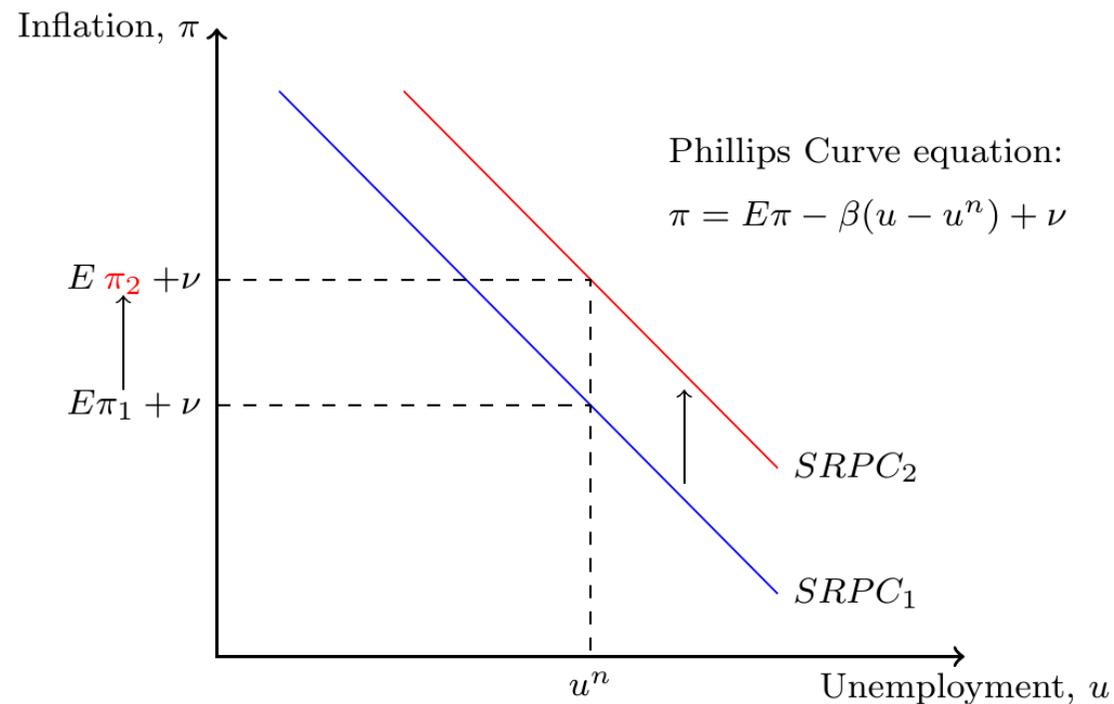
inflation resulting from demand shocks

Positive shocks to aggregate demand cause unemployment to fall below its natural rate, which *pulls* the inflation rate up.

## Shifting the Phillips curve

People adjust their expectations over time, so the tradeoff only holds in the short run.

For example: An increase in  $E\pi$  shifts the short-run Phillips curve upward.



## The sacrifice ratio

- To reduce inflation, policymakers can contract aggregate demand, causing unemployment to rise above the natural rate.
- The **sacrifice ratio** measures the percentage of a year's real GDP that must be forgone to reduce inflation by 1 percentage point.
- A typical estimate of the ratio is 5.

For example: To reduce inflation from 6 percent to 2 percent, must sacrifice 20 percent of one year's GDP:

$$\begin{aligned}\text{GDP loss} &= (\text{inflation reduction}) \times (\text{sacrifice ratio}) \\ &= 4 \times 5\end{aligned}$$

This loss could be incurred in one year or spread over several (for example: 5 percent loss for each of four years).

## Rational expectations

People base their expectations on all available information, including information about current and prospective future policies.

- Proponents of rational expectations believe that the sacrifice ratio may be very small:
- Suppose  $u = u^n$  and  $\pi = E\pi = 6$  percent, and suppose the central bank announces that it will do whatever is necessary to reduce inflation from 6 percent to 2 percent as soon as possible.
- If the announcement is credible, then  $E\pi$  will fall, perhaps by the full 4 points.
- Then,  $\pi$  can fall without an increase in  $u$ .

## The natural-rate hypothesis

- Changes in aggregate demand affect output and employment only in the short run.
- In the long run, the economy returns to the levels of output, employment, and unemployment described by the classical model .